

## PLESIOSAURS FROM ALBIAN AGED BATHURST ISLAND FORMATION SILTSTONES NEAR DARWIN, NORTHERN TERRITORY, AUSTRALIA

PETER F. MURRAY

Northern Territory Museum of Arts and Sciences,  
GPO Box 4646, Darwin, NT 5794, Australia.

### ABSTRACT

Eroded, fragmentary remains of a large elasmosaurid plesiosaur extends the range of Australian sauropterygians to the shallow Upper Albian seas of the central north of the continent. The plesiosaur is associated with abundant ichthyosaur (*Platypterygius* Von Heune) material which is also briefly described. The elasmosaurid affinity of the specimens is based on the morphology of a cervical vertebra and the large dimensions of the propodials. It resembles but can not be positively identified as *Woolungasaurus* Persson.

**KEYWORDS:** Lower Cretaceous, Upper Albian, Plesiosaur, Bathurst Island Formation, Australian ichthyosaurs, Elasmosauridae.

### INTRODUCTION

Seven unassociated postcranial fragments of a large plesiosaur were recovered during a single collecting trip to the Casuarina siltstone reef locality during a spring tide in 1985. This shore-hugging reef of dissected and slumped Lower Cretaceous Bathurst Island Formation contains an abundance of ichthyosaur vertebral centra (Murray 1985). The purpose of the outing was to attempt to locate some of the elusive appendicular material that was assumed to be present but not easily found. A conscious attempt to change the search pattern resulted not only in the recovery of some ichthyosaur limb and

girdle elements but the larger plesiosaur remains to be described. The key to locating this material was in recognition of the texture of the fossil bone in contrast to the shape-oriented search pattern determined by the distinctive disc-like form of ichthyosaur vertebral centra. It is extremely difficult to discriminate fossilized bone from the complexly eroded surface of the Casuarina siltstone unit which contains an abundance of reworked clasts or concretions that weather into organic shapes. Moreover, these are obscured by encrustations of bryozoans, calcareous tube worms, oysters and algae. Fewer ichthyosaur girdle and appendicular elements were found than the more massive

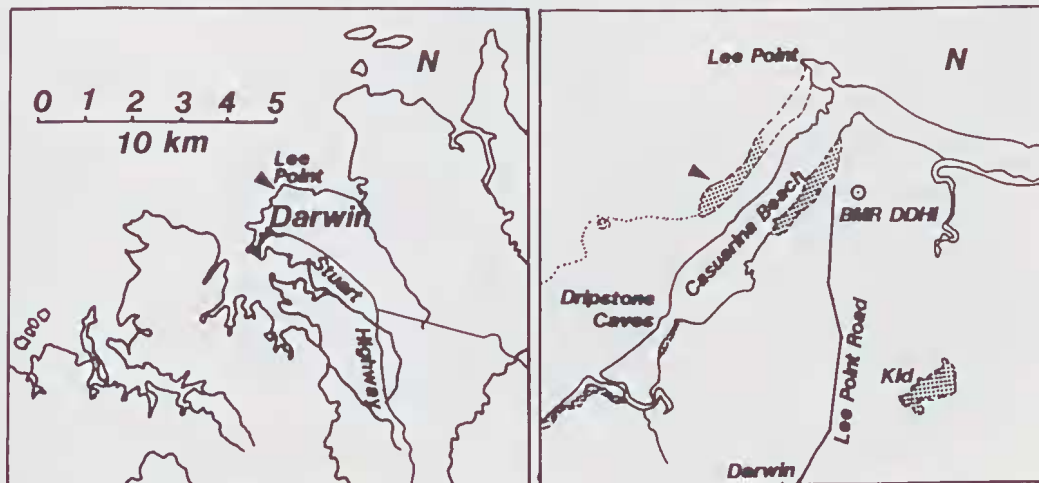


Fig. 1. Plesiosaur and ichthyosaur locality map.

plesiosaur remains despite the approximately 50 to 1 ratio of ichthyosaur vertebral centra to all other elements. Thus the collection is biased towards the size of the elements. This is clearly related to the durability of the bone because it is principally through the recognition of its eroded surface texture that it can be discriminated. Ichthyosaurs from the Darwin region were noted previously by Teichert and Matheson (1944) and Murray (1985). However, no mention of plesiosaurs from the Bathurst Island Formation could be found except for speculations in the Sydney newspapers dating back to 1924 (Murray 1985).

### CASUARINA PLESIOSAUR AND ICHTHYOSAUR LOCALITY

The Casuarina Beach locality outcrops in the area of 130 degrees 52.5 minutes E. longitude, 12 degrees 20.6 minutes S. latitude. A brief description of the locality is given by Murray (1985). The main outcrop of the Darwin Member (Bathurst Island Formation) at Casuarina beach is depicted on NTGS DARWIN sheet 5073 as a long, narrow band (Kld) lying a considerable distance behind the intertidal reef exposures from which the fossils were collected. The reefs also differ lithologically from the cliff exposures of claystone and may represent underlying siltstone beds within the unit (Fig. 1).

The low, slumped, deeply weathered and dissected reef system was given an alphanumerical designation for each segment. The fossiliferous exposures extend for approximately 750 metres in a northwesterly direction, parallel to the beach. The reefs are adequately exposed for collecting on spring tides of <1.2 metres low water. The fossiliferous sediment consists of a massive bed of fine silty claystone containing stratified or concretionary clasts of similar material which is slightly more resistant, resulting in numerous weathered irregularities that project from two to five centimetres above the surface. The claystone is soft and brittle with an unpredictable fracture plane, although it occasionally follows a horizontal weathered surface and detaches in the form of an irregular slab. Internally, the fossilized bone is surprisingly well preserved in contrast to its eroded and nodular exterior. The vertebral centra appear to be partially encased in concretionary structures and larger bones have

irregular nodules of silicified claystone adherant to or continuous with the outer surface of the bone. The interface between the bone and the matrix is consequently often poorly defined, and I have resorted to sectioning some specimens on a rock saw to determine their shape.

The fossiliferous horizon is approximately 0.3 metres thick and appears to be associated with the clastic material contained within it. A more homogeneous, darker silty claystone lies conformably below where it is exposed up to a metre or more in depth. This horizon contains long deep cracks that have been infilled with a more durable sediment. These project above the eroded surface in the form of linear structures that extend for 10 to 20 metres in some exposures. At first glance they resemble logs or even segments of pipe (the Darwin intertidal zone is littered with remnants of defensive structures installed in the harbour during World War II). It does not appear to contain an abundance of fossils of any kind.

### CASUARINA PLESIOSAURS

#### Subclass *Sauropterygia*

#### Superfamily *Plesiosauroidea* Welles 1943

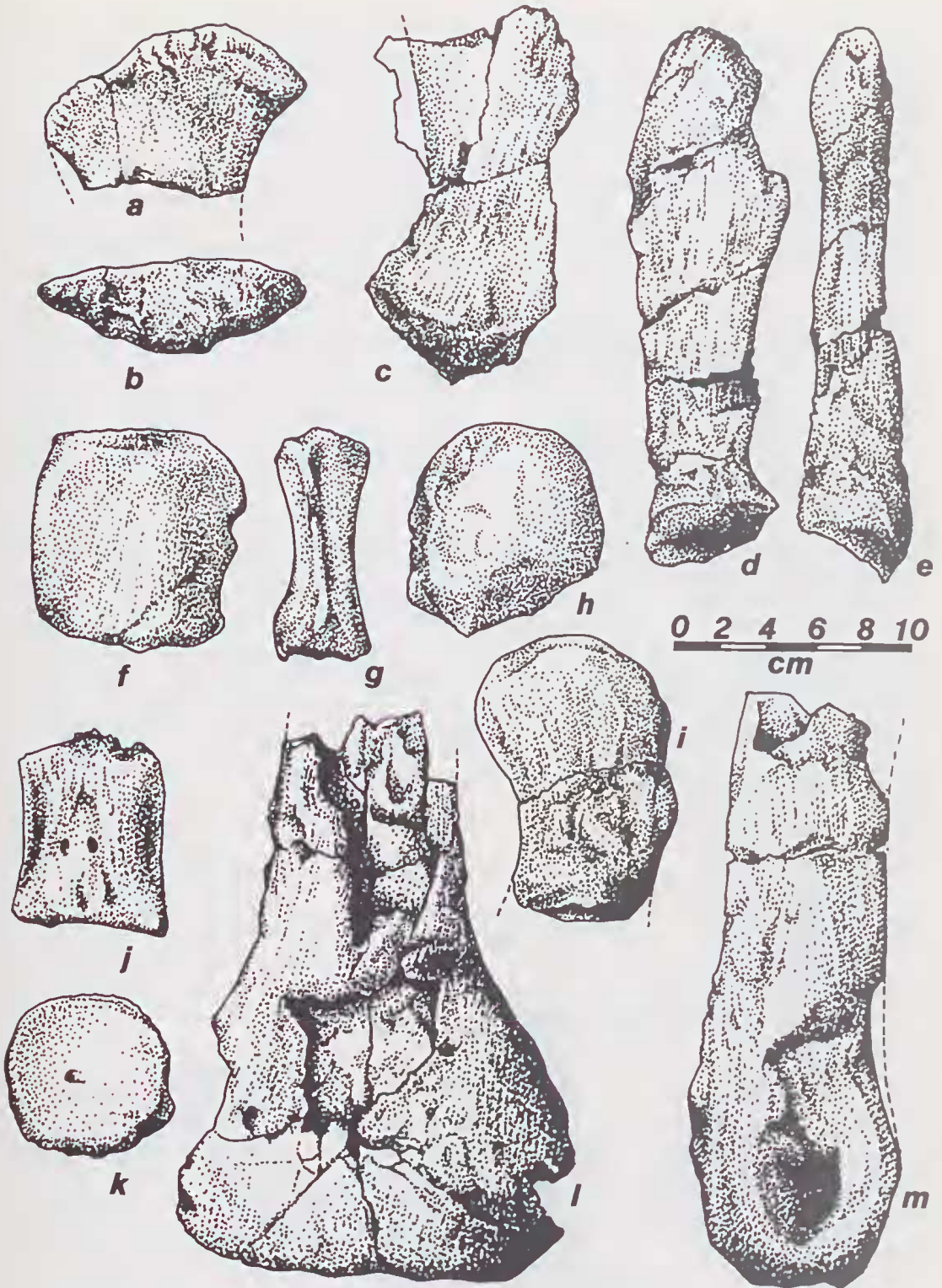
#### Family *Elasmosauridae* Cope 1869

#### Genus et species indeterminate

Geological horizon - Albion, Darwin  
Member Bathurst Island Fm.

Seven identifiable fragments of postcranial skeleton are assignable to the *Sauropterygia*. A number of additional large bone fragments were also found, that while unidentifiable, are too massive to have belonged to the ichthyosaur *Platypterygius* Von Huene. The identifiable material includes a proximal fragment of left scapula (Fig. 2 a,b) the anterodistal portion of a right humerus (Fig. 2c) a left ilium (Fig. 2 d,e) an epipodial (Fig. 4f,g) a proximal right femur (Fig. 2 g,h) a cervical vertebra, a proximal femur fragment and an epipodial which were found closer together, but as ichthyosaur vertebral centra were also present, it cannot be said that the material is associated *sensu strictu*.

**Femur.** The basic shape and proportions of this specimen conform to the description of *Woolungasaurus* Persson femora given by Persson (1960). The original outline shape and dimensions are restored in Fig. 4. The breadth across the damaged distal end is 157.0mm; diameter of the shaft, 70mm. The



**Fig. 2.** Drawings of plesiosaur fossil material; **a**, proximal fragment of left scapula, dorsal aspect; **b**, left scapula proximal aspect; **c**, anterodistal portion of right humerus, extensor aspect; **d**, **e**, left ilium; **f**, **g**, epipodial; **h**, **i**, proximal right femur; **j**, cervical centrum, ventral aspect; **k**, cervical vertebra, articular aspect; **l**, distal femur, extensor aspect; **m**, distal femur right anterior aspect.

total length of the fragment is 230.0 mm. A damaged proximal femur fragment from the same (right) side preserves a portion of the shaft and about 80% of the circumference of the capitulum is 71.0mm anteroposteriorly and the diameter of the diaphysis is 66.5mm. This specimen is slightly smaller in the dimensions of its shaft, which also overlaps the break in the shaft of the first specimen.

**Humerus.** This is a fragment of the extensor face of a large propodial, probably a right humerus.

**Epipodial.** A specimen of a well preserved tibia or fibula, length, 94.0mm, width 85.0mm; proximal thickness, 35.0mm; distal thickness, 34.0mm.

**Ilium.** This is a poorly preserved slightly curved, elongated, flat girdle element. Proximally, the shaft becomes more robust and oval in section. A border of the actabulum appears to present. The fragment is 235.0mm long and 30.0mm thick in the mid-region. Its maximum width is 72.0mm.

**Vertebral centrum.** An elongated cervical vertebra with a pair of ventrally situated nutrient foramina lead into a central cavity within the body of the centrum as determined from sectioning the specimen. This distinctive vertebral chamber in plesiosaurs was first noted by Molnar (1982). A ventral keel separating the foramina is not visible, but the specimen is so badly eroded that a narrow crest may have once been present. There is

partial preservation of an elongated dorsolateral crest on one side of the specimen. The outline shapes of the articular surfaces are ovoid, broader ventrally and slightly flattened dorsally. The articular facets are shallowly concave. An oval foramen-like structure is present near the centre of the best preserved face. The quality of the specimen is extremely poor but sufficient to indicate its affinity with the dolichodiran plesiosaurs. The dimensions of the specimen suggest that it is not *Woolungasaurus glendowerensis* Persson, but an elasmosaurid form with longer and narrower cervical centra. The length of the centrum is 80.5mm; height 61.0mm and width, approximately 75.0mm. Persson (1960) described a specimen in the Queensland Museum with similar proportions (QM, F. 2386) which he considered to be specifically and possibly generically distinct from *W. glendowerensis*. Unfortunately both assemblages are too poorly preserved and represented to form the basis of a description (Fig. 4, Table 1).

The elasmosaurid affinity of this material is expressed by the presence of a cervical centrum, longer than high, with a lateral longitudinal ridge. The propodials are short and stout as in elasmosaurids and closely match those figured by Persson (1960) for *Woolungasaurus*. The epipodial is eroded and damaged on one side but would appear to have been as broad as or broader than long.

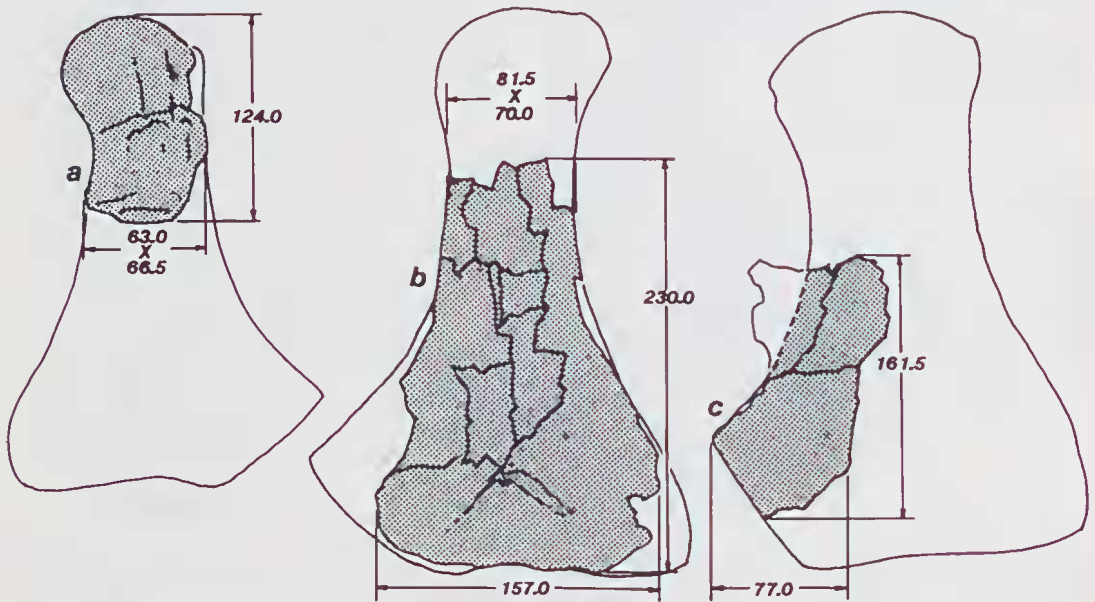


Fig. 3. Restoration of plesiosaur propodial fragments: a, proximal femur; b, distal femur; c distal humerus.

# CASUARINA ICHTHYOSAURS

Subclass Ichthyopterygia  
Genus *Platypterygius* Von Huene 1932  
Species Indeterminate

Geological horizon - Albian, Darwin  
Member Bathurst Island Fm.

Some fragments of ichthyosaur appendicular and limb girdle elements are figured as a supplement to a previous description of inde-

terminate ichthyosaurs of the Darwin Member (Murray 1985). Identifiable material includes a proximal humerus fragment (Fig. 5 a, b) and two fragments of scapulae (Fig. 5c,d,e). As anticipated, these are morphologically compatible with the genus *Platypterygius*, but lacking the diagnostic distal end of the humerus, the species remains undetermined. Dimensions and restorations of the fragments are given in Figures 6,7,8.

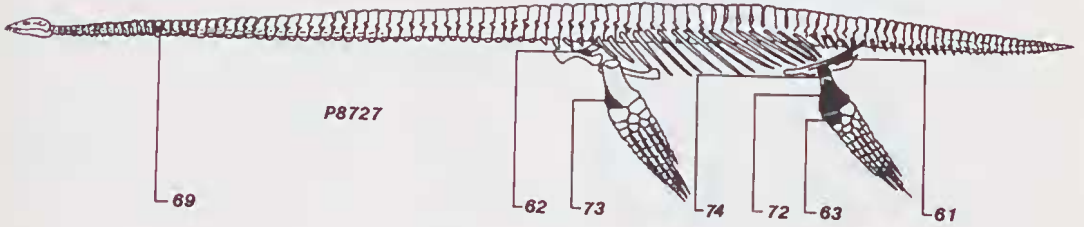


Fig. 4. Diagram showing representation of fossil plesiosaur material from the Casuarina Beach locality, P87 27-69, (cervical vertebra-62) scapula, -73) humerus, 74) femur-72) femur, -63) cypodial -61) ilium.

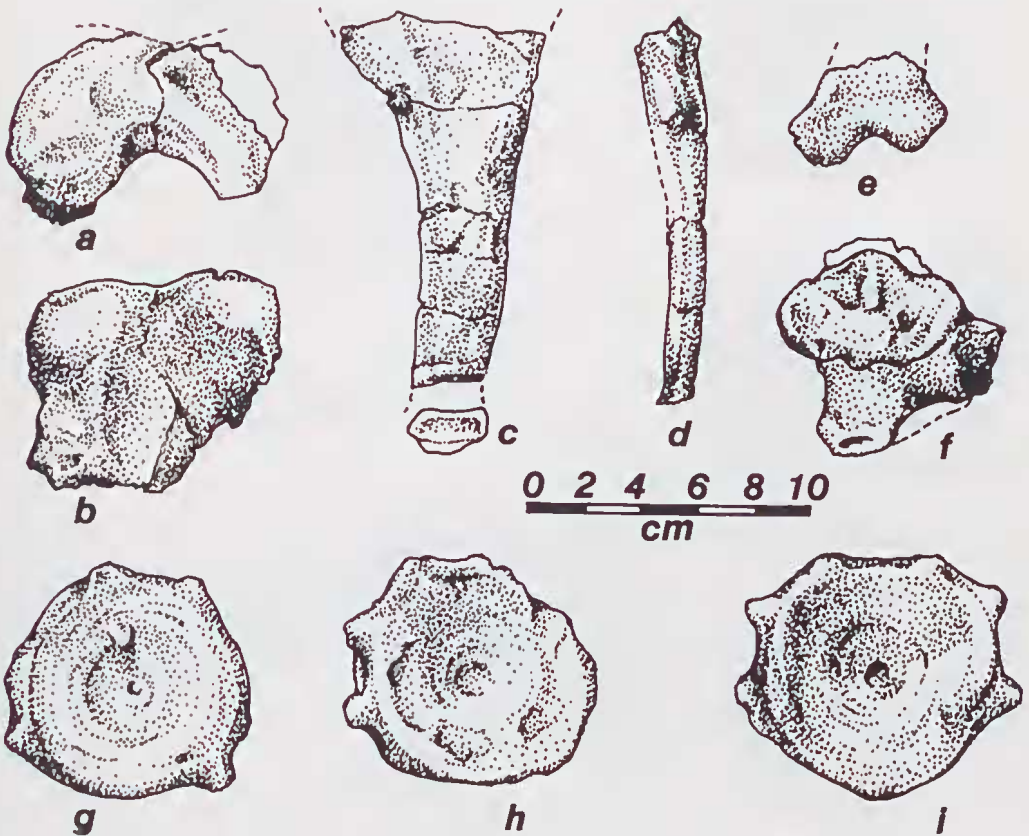


Fig. 5. Ichthyosaur fossils from the Casuarina Beach Locality: a, proximal humerus; b, proximal humerus, dorsal aspect; c, scapular blade, lateral aspect; d, scapular blade, axillary aspect, e, proximal scapula fragment, f, example of one of many unidentified weathered fragments of ichthyosaur bone; g,h,i, well preserved vertebral centra.

**Humerus.** This is a proximal fragment of a left humerus with a low, gently rounded capitulum and a prominent dorsal trochanter which is partially damaged and obscured by matrix. Its proportions and outline shape are similar to the University of Wyoming *P. americanus* Nace specimen (UW 2421) described by McGowan (1972) and OM F 2573 figured in Wade (1984).

**Scapulae.** Two scapula fragments represent a right scapular blade missing its posterior border and a heavily seoured left proximal portion. The dorsal border of the blade shows no evidence of the thickening or development of a crest as illustrated by Broili (1907) for *P. platydactylus* although the curvature of the axillary border and its relative proportions are apparently much alike. The acromial process appears to be narrower and

deflected more dorsally than that of *P. platydactylus* and the dorsal surface appears to have been narrower and either only slightly expanded or straight. Because of its small size, I initially thought the fragment was a portion of neural arch but the broken end is too wide and was clearly continuous with a broad, flat bone.

In addition to the new postcranial material, a more comprehensive collection of ichthyosaur vertebral centra was made with many of the specimens in fairly good condition (Table 1; Fig. 5g,h,i). Some examples have quite large diameters (NTM, P87270-25 is 109.0mm. dorsoventrally) but all appear to lie within the known range of *Platypterygius australis* McCoy; none attain the large sizes reported for some New Zealand Upper Albian ichthyosaurs (Fleming, Gregg and Welles, 1971).

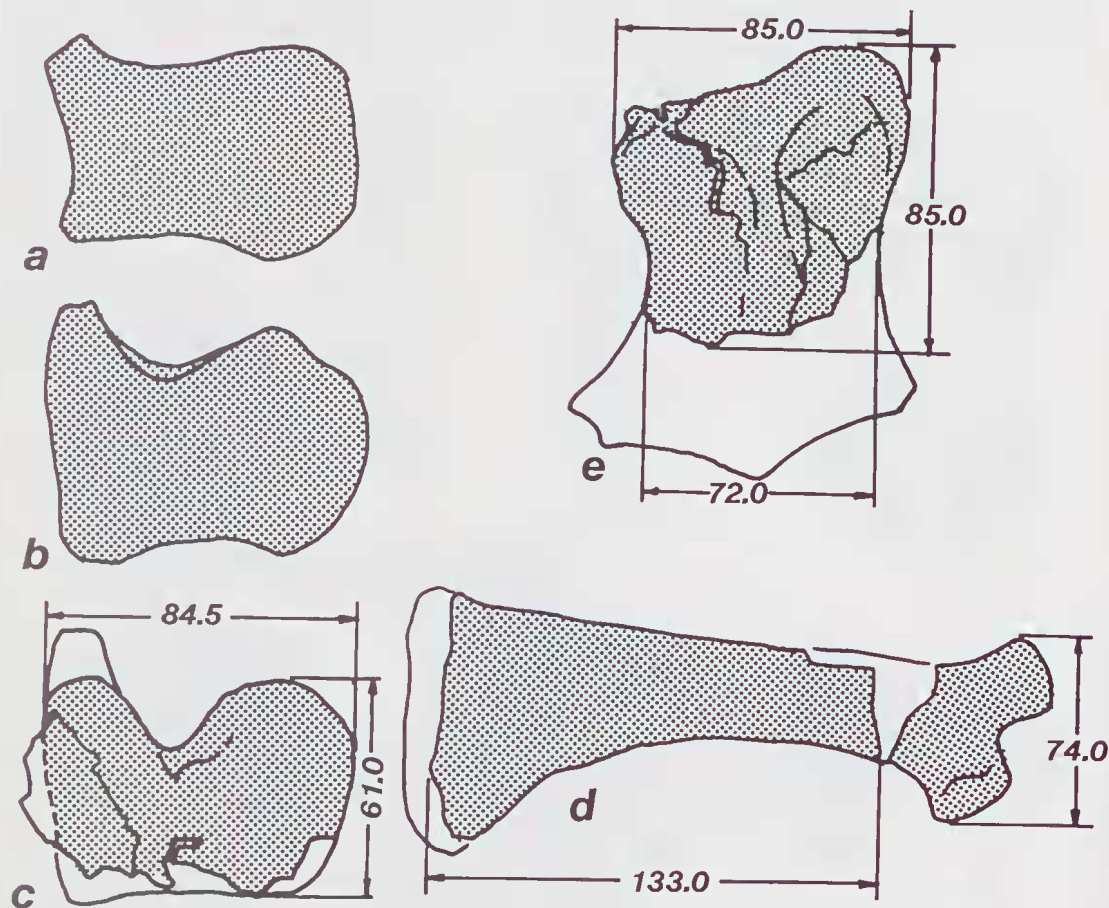


Fig. 6. Restoration of ichthyosaur girdle and limb bone fragments: a, proximal humerus after Wade (1984); b, proximal humerus after McGowan (1972) c, proximal humerus, articular aspect; d, scapula, lateral aspect; e, dorsal aspect.

**Table 1.** Measurements (mm) of ichthyosaur and plesiosaur vertebral centra. D = diameter; H = Height; L = length

<i>Ichthyosaur</i>							
<i>Cat. No.</i>	<i>Length</i>	<i>Diameter</i>	$\frac{L}{D}$	<i>Cat. No.</i>	<i>Length</i>	<i>Diameter</i>	$\frac{L}{D}$
P8727-39	33.0	79.0	.42	P8727-26	26.0	70.0	.37
61	33.0	74.0	.45	19	30.5	102.5	.29
47	32.5	91.0	.36	23	27.5	63.5	.43
46	34.0	94.0	.36	15	37.5	92.0	.41
48	23.0	86.0	.27	21	34.5	82.0	.42
51	32.5	84.0	.38	22	16.0	50.0	.32
49	31.5	71.0	.44	17	38.0	99.5	.38
50	27.5	93.5	.29	2	28.0	72.5	.38
54	21.0	97.5	.21	1	25.5	75.0	.34
52	35.0	91.0	.38	16	36.0	80.5	.45
53	34.0	-	-	41	39.5	-	-
57	37.0	102.0	.36	7	38.5	78.5	.49
59	29.0	82.0	.35	6	27.0	88.0	.31
58	32.0	80.5	.40	4	35.5	98.0	.36
38	34.0	85.0	.40	12	34.0	86.0	.39
44	26.0	82.0	.32	11	33.5	75.0	.45
43	36.5	75.0	.49	10	41.0	-	-
24	29.5	82.5	.35	14	42.5	82.0	.51
33	35.5	90.0	.39	5	38.0	88.0	.43
35	36.0	-	-	20	42.0	95.5	.43
36	22.0	-	-	-	42.5	105.0	.40
34	27.5	-	-	-	41.5	93.0	.44
31	33.0	87.0	.38	-	40.5	107.0	.38
28	24.5	78.0	.31				
29	25.5	-	-				
30	25.5	-	-				
32	25.5	-	-				
37	40.5	75.0	.54				
42	23.0	77.0	.30	<i>Cat. No.</i>	<i>Length</i>	<i>Diameter</i>	$\frac{H}{L \text{ index}}$
27	33.0	75.5	.44	P8727-70	80.5	61.0	.75

## DISCUSSION

This and the previous note (Murray 1985) conclude a preliminary investigation of the Cretaceous rocks in the immediate area of Darwin for fossil vertebrate material. Probably no more than the equivalent of two or three days searching over a very small portion of the known distribution of local outcrops of equivalent age have resulted in a substantial collection of material representing at least two genera of large marine reptiles. While there is no doubt as to the relative abundance of such material, the difficulty of discerning the fossils, the limitations placed by the tides on collection time and the possibility that much of the skeletal material has been scattered and damaged by

depositional agencies must be taken into balance against overly optimistic view of the prospects. Having stated the obligatory cautions, systematic and detailed work on the problem will commence in 1987-88. The major projects are 1) a revised stratigraphic correlation of the vertebrate bearing unit (2) detailed sedimentological and petrographic analysis of the vertebrate-bearing rocks and modes of fossilization 3) assessment of the invertebrate fossils associated with vertebrate material 4) identification of fossil wood and other organic traces including a study of trace fossils, in conjunction with the Museum's Curator of Worms, 5) bulk collecting from known localities and survey for new sites extending to Cox peninsula to the west of Darwin and Gunn Point to the East.

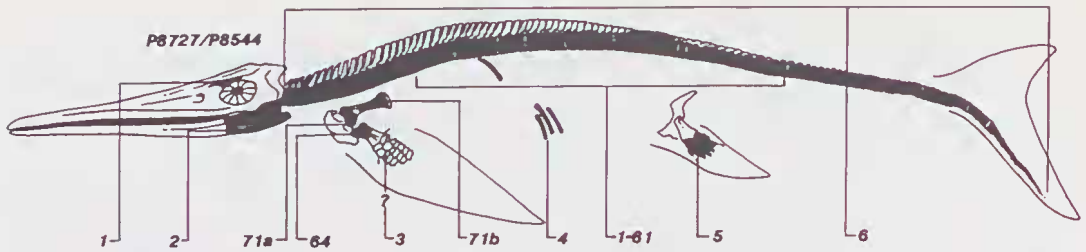


Fig. 7. Representation of Darwin area ichthyosaur fossils, including the articulated specimen from Nighcliff (Murray 1985). P8544-1) prefrontal fragment -2) angular and surangular P8727-71a proximal scapula P8727-64) proximal humerus P8544 ?-3) paddle trace, P8727-71b) scapular blade P8544-4) ribs, P8727-1-61) vertebral centra, P8544-5) hind paddle trace, P8544-6) centra

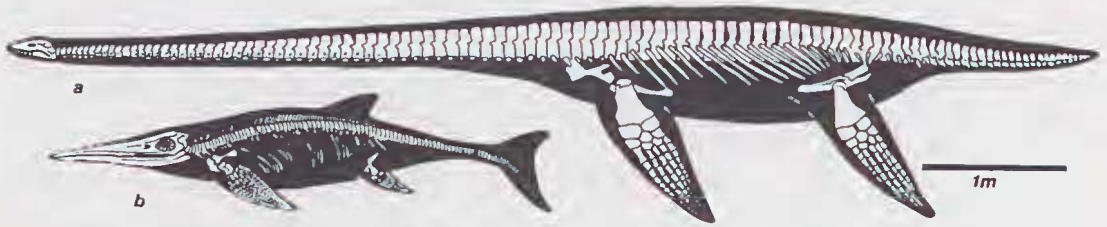


Fig. 8. Scale restorations of Darwin Area plesiosaur and ichthyosaur, based on sizes of representative fragments: a, *Elasmosauridae* gen. et sp. indet., b, *Platypterygius* sp.

## SUMMARY

Dolichodiran plesiosaurs (elasmosauridae) and ichthyosaurs, *Platypterygius* sp. occur in the Albian Darwin Member of the Bathurst (= Mullaman Beds, Skwarko 1966) Formation Island as scattered and partially articulated material in a generally poor state of external preservation. Internally, the material retains finely detailed structure, suggesting that bulk sampling and careful preparation may produce some fine specimens. Whether or not the vertebrate fossils are derived from equivalent horizons within the member is yet to be determined. The Casuarina locality is lithologically distinct and possibly lower in the sequence than the Nighcliff ichthyosaur (phosphorite nodule) bed.

Sufficient appendicular material has been found to indicate that the ichthyosaur is genus *Platypterygius*. The plesiosaur material is indeterminate below family designation (*Elasmosauridae*).

## ACKNOWLEDGEMENTS

Drs Ralph Molnar's and Andrew Rozenfeld's comments on the manuscript are greatly appreciated. Thanks are also extended to Dirk Megirian and Russ Hanley

who participated in the collecting trips and discussions of the material and to Lorna Watt for her usual keyboard finesse and patience.

## REFERENCES

- Broili, F. 1907 Ein neuer ichthyosaurus aus der norddeutschen Kreide *Palaeontographica* 12:139-162.
- Fleming C, Gregg, D. and Welles S. 1971 New Zealand ichthyosaurs — a summary, including new records from Cretaceous. *New Zealand Journal of Geology and Geophysics* 14:734-741.
- McGowan, C. 1972 The systematics of Cretaceous ichthyosaurs with particular reference to material from North America. *Contributions to Geology* 11(1): 9-29.
- Molnar, R. 1982 Australian Mesozoic Reptiles. In, P.V. Rich and E.M. Thompson, eds. *The Fossil Vertebrate Record of Australasia*. Monash University offset Printing Unit: Clayton.
- Murray, P. 1985 Ichthyosaurs from Cretaceous Mullman Beds near Darwin, Northern Territory. *The Beagle, Occasional Papers of the Northern Territory Museum of Arts and Sciences* 2(1): 39-55.
- Persson, O. 1960 Lower Cretaceous plesiosaurs (Reptilia) from Australia. *Lunds Universitets Arsskrift. N.F. Adv.* 2 56 (12): 1-23.
- Teichert, C. and Matheson, R. 1944 Upper Cretaceous ichthyosaurian and plesiosaurian remains from Western Australia. *Australian Journal of Science* 6: 167-178.
- Wade, M. 1984 *Platypterygius australis*, an Australian Cretaceous ichthyosaur *Lethaia* 17: 99-113.

Accepted 27 July 1987